# DEW IN THE MISSISSIPPI DELTA IN THE FALL

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## ABSTRACT

Dew, which affects many agricultural crops in many different ways, affects the quality of harvested cotton in the Mississippi Delta. For this reason, a study of dew in this area was made.

Dew was measured by collectors patterned after the Duvdevani dew block. Vertical variation was observed at 10 levels above the ground from 3 to 72 in. Dew intensities normally decrease with height. The rate of change was larger below 24 in. than above. Area variation at the 24-in. level was measured at five Delta locations. Differences in dew intensity were less between stations 40 mi. apart than between stations 150 mi. apart.

Vertical variation of dew, expecially below 24 in., appears to be a micrometeorological phenomenon and thus not subject to conventional forecast techniques. Areal variation of dew at the 24-in. level appears to be a macrometeorological phenomenon which is subject to conventional forecast techniques.

## 1. INTRODUCTION

Dew is an important, but ofttimes neglected, agricultural weather element. In the Mississippi Delta, cotton is still "King." And in the Delta, as well as in most of the rest of the Cotton Belt, dew influences the quality of the crop. If American cottons are to continue to sell on the world market, they must maintain a high quality.

Surfaces wet with dew promote the development of fungi causing boll rot on growing cotton. This reduces quality. Prior to harvesting, dew is necessary to activate chemicals used to defoliate the cotton plant. But cotton harvested wet with dew suffers a loss of quality [1]. Thus dew is sometimes desirable and sometimes not. Knowledge about dew, however, is not only desirable but necessary in the effort to maintain cotton quality.

This report of some dew variability measurements is part of a continuing joint study encompassing the broad-scale effects of surface moisture on cotton quality by the Weather Bureau, the Mississippi State University, and the U.S. Department of Agriculture [2]. In addition to its effect on cotton quality, dew affects many other agricultural crops in many different ways. Information from this study may be applicable in some of these other dew-crop relationships.

Water condenses on a surface when the temperature of that surface drops below the dew point of the ambient air. Radiation is the usual method of cooling the surface, and sufficient outgoing radiation combined with an adequate moisture supply is necessary for dew formation.

Clouds, dust, and high humidity reduce the effective outgoing radiation. Also the effective radiation from a surface is dependent upon the radiational characteristics of the surface itself.

Water droplets on exposed surfaces not resulting from precipitation are classified by the gross term "dew." Where does this moisture come from?

1. Dewfall or condensation of water vapor from the atmosphere.
2. Distillation or condensation of water vapor from transpiring lower leaves or warmer moist soil.
3. Fog interception by leaves or other exposed objects.
4. Guttation or exudation of liquid by portions of leaves.

In continental, mid-latitude areas, distillation dew probably makes the largest contribution throughout the growing season [3]. On rare nights of heavy fog, this source accounts for the highest individual dew totals [4].

Air movement affects dew formation. Monteith [5] and others found some wind necessary for heavy dew deposition. Maximum deposits on a meadow occurred with wind speeds over 1 m.p.h. at 2 m. above the ground. With calm air, the moisture supply adjacent to the surface becomes depleted; if it is not replenished, dew drop growth slows. When the wind speed exceeds a certain critical value, dew formation ceases and evaporation begins.

Surface radiation characteristics, local moisture sources, and small-scale air circulations are usually considered as micrometeorological elements. Dew intensity, which in large part is determined by these three conditions, varies widely over relatively short distances, both horizontally and vertically. To make practical dew forecasts, we must translate these conditions from the micro- to macroscale, and this is the objective of this report.

Many recorders have been tested in an effort to evaluate dew variation and its effect on cotton. In the studies reported here, dew observations were made on collecting surfaces patterned after the Duvdevani [6] dew blocks. Cottonwood blocks (1 in. x 2 in. x 12 in.) were finished with a very hard and durable plastic surface and then treated to form a suitable dew collecting surface. Results of other experimenters have indicated satisfactory results with the Duvdevani blocks. For example, Mukammel et al. [7] stated, "Total dew measured on artificial surfaces seems to be roughly equal to that of a natural surface . . . the gauges are useful as indicators of dew formation. . . ."

## 2. AREAL DEW VARIATION

The Mississippi Delta, that area in Mississippi which borders the Mississippi River, is an ideal laboratory for studying areal variation of weather elements. It is very flat. Soils, crops, and crop practices are homogeneous.

During the cotton harvest season of September and October, dew intensity was measured at 40- to 50-mi. intervals on a north-south line at five Delta stations: Tunica, Clarksdale, Stoneville, and Rolling Fork, Miss., and Tallulah, La. The two most widely separated stations, Tunica and Tallulah, are 165 mi. apart.

Dew blocks were placed at the 24-in. level. Ten dew intensity classes were measured: zero indicating no dew, 1–3 light dew, 4–6 moderate dew, and 7–9 heavy dew. During the period, the average dew intensity was: Tunica 4.3, Clarksdale 4.5, Stoneville 3.7, Rolling Fork 3.5, and Tallulah 4.1.

Figure 1 shows the frequency of occurrence of the various dew intensities at all five Delta stations. Grouping according to major classes gives: heavy dew 32 percent of the time, moderate dew 21 percent, light dew 28 percent, and no dew 19 percent. On a few days, clouds blanketed a small section of the area and no dew occurred at one or two stations while heavy dew occurred at the other stations. On other days, the entire area had the same class of dew. But on most days, there was a variation over the area. Often this was represented by a north-south gradient with heaviest dew either in the north or the south.

The average difference in dew intensity between each possible pair of stations was compared with the distance between the two. Figure 2 shows this relationship. The correlation coefficient for the 10 measurements was 0.78, which is significant at the 1 percent level.

Although dew is considered to be a micrometeorological phenomenon by many [8], this relationship indicates that stations close together are more likely to have the same amount of dew than are stations far apart. In this respect, we emphasize that the area of measurement is quite homogeneous in topography, soil, crop, and crop practice. But in respect to rainfall, the area often shows big variations. September 1963 rainfall varied from 0.1 in. to a little over 3 in. There was no rain reported in

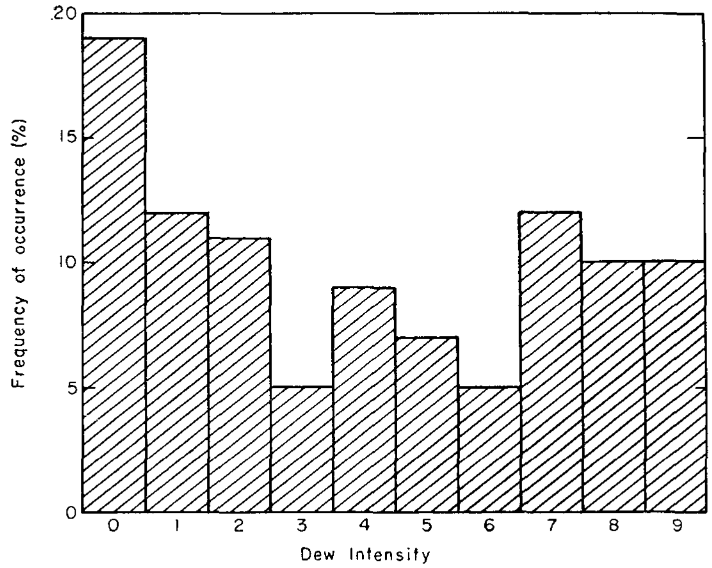


FIGURE 1.—Frequency of occurrence of dew intensity at five stations in the Mississippi Delta in September and October 1963.

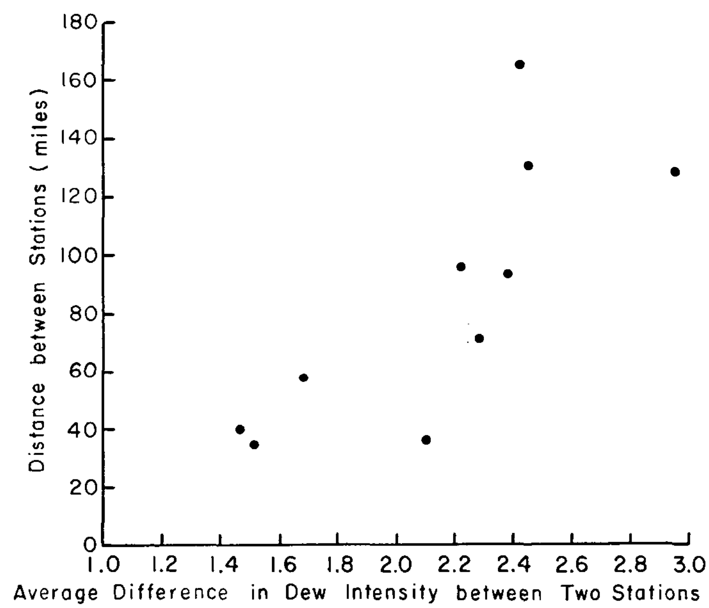


FIGURE 2.—Relation between the average difference in dew intensity between two stations and the distance between the stations. Data from 5 stations in the Mississippi Delta during September–October 1963.

October. Oddly, Clarksdale reported both the heaviest average dew intensity and the lowest rainfall. Heavy showers a short distance from the observation station, however, assured a large supply of nearby moisture.

Dew observations were also made at Oak Ridge, La., which is only 40 mi. west of Tallulah. Oak Ridge had over 5 in. of rain compared with 0.5 in. at Tallulah. Heavy rain, combined with the rolling topography associated with Oak Ridge's location, produced an average dew intensity of 6.1 at Oak Ridge compared with 4.1 at

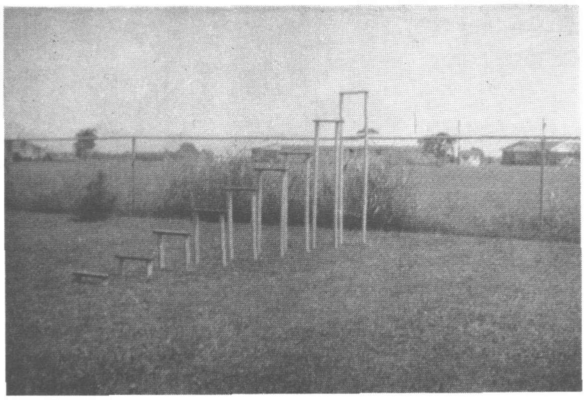

FIGURE 3.—Dew blocks were placed at 3, 6, 12, 18, 24, 30, 36, 48, 60, and 72 in. above the grass-covered ground at Stoneville, Miss., observation site.

Tallulah. Both topography and rainfall influence dew intensity.

## 3. VERTICAL VARIATION OF DEW

Dew deposition was measured at Stoneville, Miss. from August 24 to October 23, 1963 at ten levels: 3, 6, 12, 18, 24, 30, 36, 48, 60, 72 in. The intensity was classified in 28 categories in this part of the experiment: zero for no dew; 1–9, light; 10–18, moderate; and 19–27, heavy dew. The senior author took the observations each morning; thus the variation resulting from differences in observers' judgments was minimized.

Figure 3 shows the placement of the blocks. The ground underneath was in grass lawn. The 61-day observation period was unusually dry with only 2.93 in. of rain, most of which fell during the middle of the period. A small lake, covering about 5 acres, was located ¼ mi. to the east. The ground in all directions was flat. There were small trees and houses widely spaced over a radius of about ¼ mi., but there were no wind obstructions within a radius of 150 ft.

The four sources of moisture associated with dew deposition mentioned in the Introduction play an important role in vertical variation of dew. Duvdevani [9] found that dew deposition during the dry summers characteristic of Israel increased with distance from the ground. But during the normally wet winters, the opposite dew gradient was found. Lloyd [10] reported that dew deposit at 5 ft. averaged twice that at the 1-ft. level during his 5-day period of measurement in northern Idaho.

The average dew intensity for 10 levels above the ground is shown in figure 4 for the 49 nights on which dew occurred at the 3-in. level. Three rather definite zones appear on the curve. From 3 in. to 6 in., the decrease in dew intensity is sharp. From 6 in. to 24 in., the drop is somewhat less. From 24 in. to 72 in., the decrease is least. The relationship in this latter zone is nearly linear. None of the 49 cases of dew showed an increase in dew intensity with increasing height. This suggests that

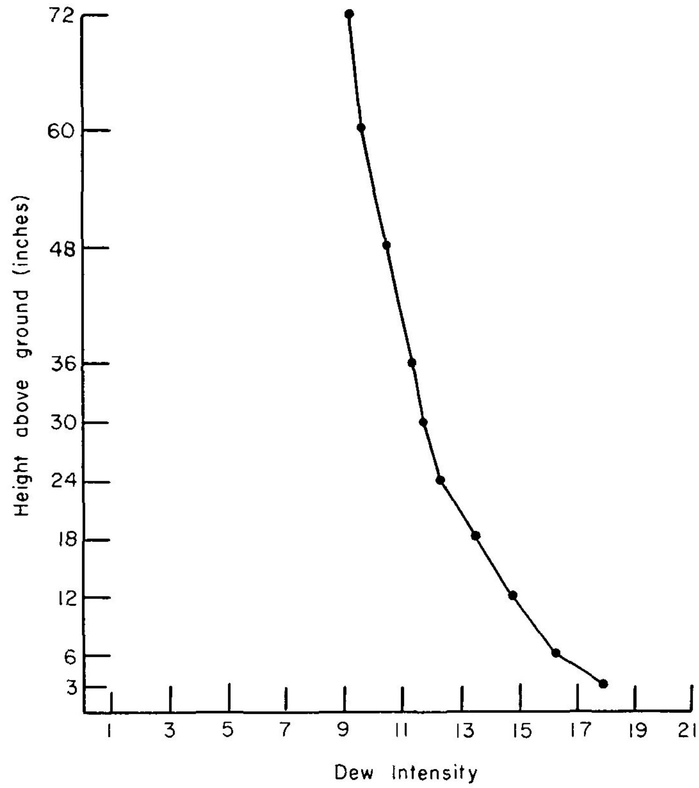


FIGURE 4.—Average dew intensity at 10 heights above the ground for 49 days with dew at the 3-in. level from August 24–October 23, 1963, at Stoneville, Miss.

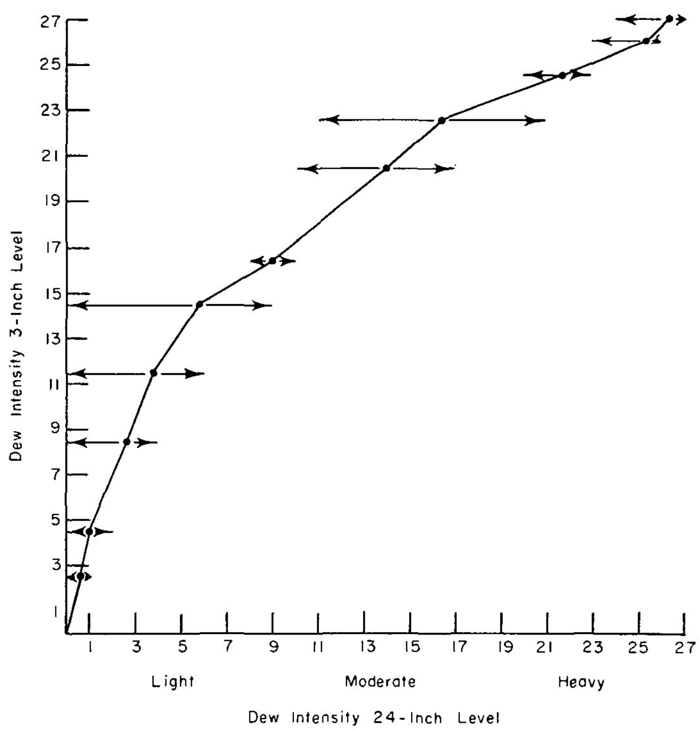


FIGURE 5.—Relation between dew intensity at 3 in. and 24 in. in Stoneville, Miss., August 24–October 23, 1963. Arrows show range of observations; for example, when dew intensity at the 3-in. level was 20 or 21 (low end of heavy dew scale) dew at 24 in. averaged 14 (middle of the moderate dew scale) but ranged from 17 to 10 (nearly the full range of the moderate dew scale).

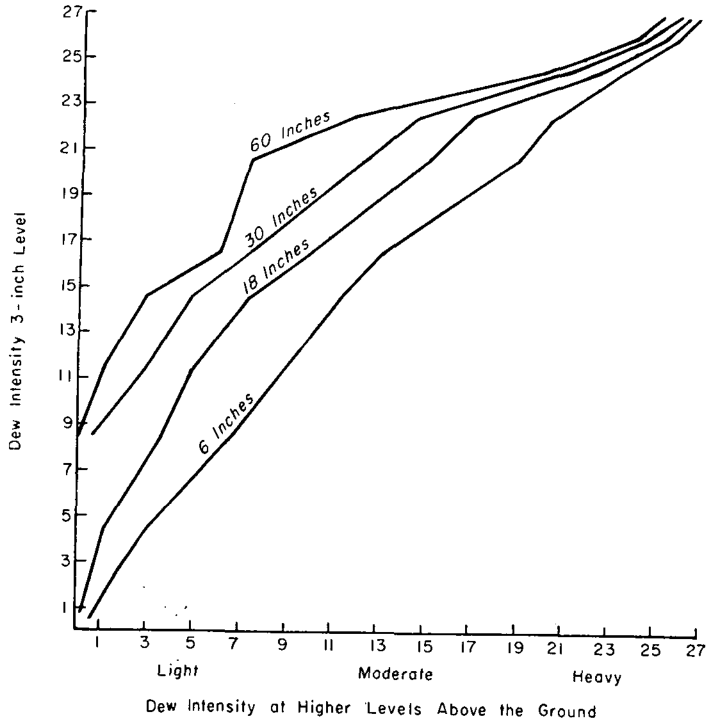


FIGURE 6.—Relation between dew intensity at the 3-in. level and at the 6-, 18-, 30-, and 60-in. levels at Stoneville, Miss., August 24–October 23, 1963.

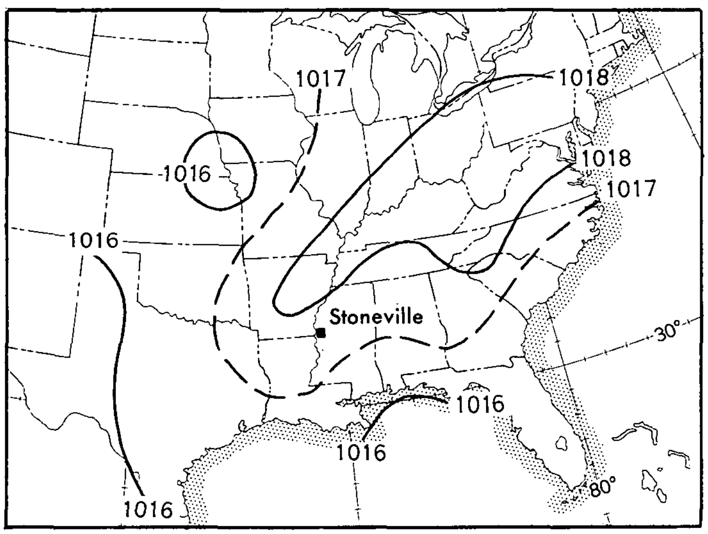


FIGURE 7.—Average sea level pressure in millibars at 12 midnight for 10 days when heavy dew was recorded at all levels from 3 to 72 in. above the ground, August–October 1963, at Stoneville, Miss.

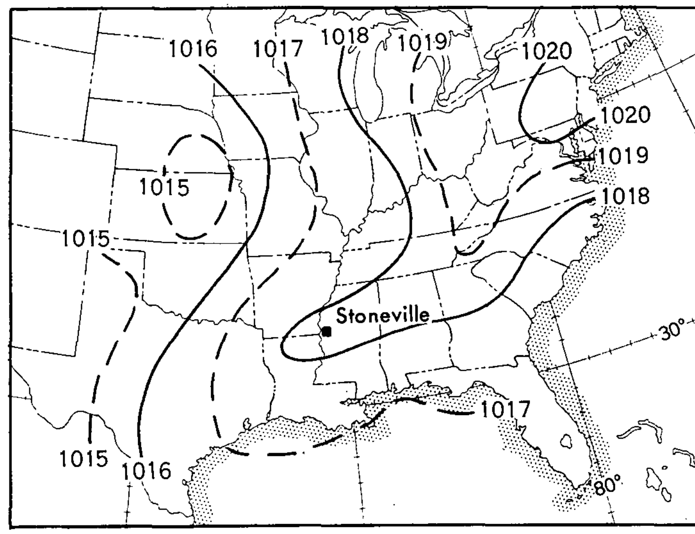


FIGURE 8.—Average sea level pressure in millibars at 12 midnight for 9 days when dew was heavy at the 3-in. level but light at the 36-, 48-, 60-, and 72-in. levels, August–October 1963, at Stoneville, Miss.

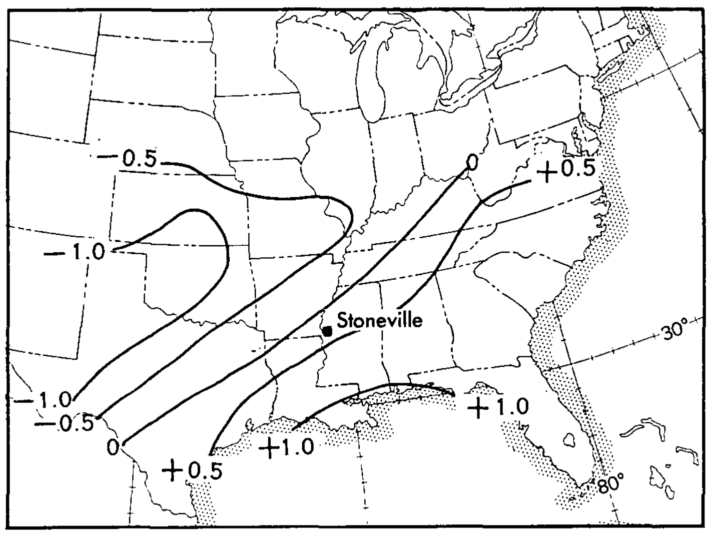


FIGURE 9.—Difference in sea level pressure between figure 7 and figure 8. Low pressure to the northwest and high pressure to the southeast indicates that light dew at 36, 48, 60, and 72 in. occurs with a stronger relative flow from the southwest than is evident when heavy dew occurs at all levels.

distillation dew was the main source of moisture, a result that is consistent with Penman's [11] finding that "moisture from the air formed a very small proportion only of dew, which was essentially composed of moisture from earth."

During the 61-day period of observation, rain fell on 4 nights. Of the remaining nights, some dew occurred at the 3-in. level on 49 nights while no dew occurred on 8 nights. Heavy dew was measured at the 3-in. level on 26 nights, moderate dew on 17 nights, and light dew on 6 nights. Eighteen of the 26 cases of heavy dew occurred during the first half of the experiment. Less moisture was available for the formation of distillation dew as the season advanced; thus the excess of heavy dews in the early half suggests that this source is highly important during the early part of the season.

Figure 5 shows the relation between dew intensity at the 3-in. and 24-in. levels. When very heavy dew was observed at the 3-in. level, dew was also heavy at the 24-in. level. The arrows show the range of the 24-in. intensity for the various 3-in. intensities.

When the dew intensity at the 3-in. level was near the bottom of the heavy dew range (20 and 21), the dew intensity at the 24-in. level was moderate (10 to 17). When dew was moderate at the 3-in. level (14 to 15), dew averaged light at 24 in. and ranged on the scale from 9 all the way down to zero.

As stated in section 2, observations in the experiment on areal variation of dew were made at the 24-in. level. Observations in this study indicate that dew measurements at the 24-in. level will not account for some cases when dew was moderate at the 3-in. level. This is important in deciding how high to place dew blocks in an experiment. Data in figures 4 and 5 suggest that the 24-in. level minimizes moisture from the distillation process and from guttation from grass. For an area observational program emphasizing macro- rather than micrometeorological conditions, the 24-in. level appears better suited in this area than the 3-in. level.

Figure 6 shows the average dew intensity at 6, 18, 30, and 60 in. compared with dew intensity at 3 in. The pattern is quite similar to figure 5. Dew intensity never increased with height.

Dew observations made at Stoneville in the fall of 1960 were related by Riley [2] to sea level pressure patterns. The pattern related to heavy dew featured a large high pressure system over Iowa and Wisconsin with a ridge extending southward over northern Mississippi.

Dew observations in this current study are related to sea level pressure patterns in figure 7, 8, and 9. When heavy dew occurred at all levels from 3 to 72 in., the average sea level pressure pattern consisted of high pressure over the Ohio River Valley with a ridge extending through northeastern Arkansas (fig. 7). When dew intensity was light at the 3-, 4-, 5-, and 6-ft. levels, but heavy at 3 in., the typical sea level pressure pattern still showed high pressure to the northeast (fig. 8). But in this case, the ridge near the Delta area was right over the observation point. Figure 9 shows the difference in sea level pressure between the two cases. With light dew at the upper levels, the pressure was higher to the southeast and lower to the northwest. This means that between the two types of dew patterns the relative air flow was more southwesterly when light dew intensities occurred at the upper levels. This may be interpreted physically in two manners: (1) Southwesterly flow into the Mississippi Delta normally brings drier air. (2) Northeasterly flow brings in moisture on the small scale by advecting vapor from the small lake just ¼ mi. upstream.

Pressure patterns associated with heavy dew and those associated with no dew at the 24-in. level in the 1963 experiments conform with the typical map patterns found in 1960 [2]. There are significant macrometeorological pattern differences between heavy dew and no dew, but there appear to be no significant pressure pattern differences with vertical variation. These conclusions suggest that the vertical variation, especially below the 24-in. level, is probably more influenced by micro- than macrometeorological conditions.

## 4. CONCLUSION

Dew intensity decreases with height above the ground in the Mississippi Delta from August through October. The rate of decrease is rapid from 3 to 6 in., less from 6 to 24 in., and least from 24 through 72 in. Measurements below 24 in. are closely related to micrometeorological conditions. The difference in dew intensities at the 24-in. level between stations 40 mi. apart is less than between stations 150 mi. apart in the flat homogeneous Mississippi Delta area. Dew intensity at the 24-in. level is related to the sea level pressure pattern; vertical variation of dew is apparently not. Areal variation (24-in. level) is a macrometeorological phenomenon and is subject to conventional forecast techniques. Vertical variation is a micrometeorological phenomenon and does not appear subject to conventional forecast techniques.

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